the book is higher than that at which they can be laid in the neighbourhood of provincial towns.

Nearly half the book is devoted to a description of the materials used in the maintenance of roads and to their petrology, a subject which should be carefully studied by road surveyors. The authors very clearly show that it is more economical to procure suitable material from a distance than to employ local stones because the first cost is less. There is a very considerable difference in the wearing qualities of different kinds of stone, the reasons for which are clearly shown in the book.

The chapter on the construction of roads gives information which is now little required in this country, but would be of service to a surveyor in the colonies; those on maintenance and cost contain a great many useful and practical hints. The observations under the last head are well worth the consideration of all authorities having charge of the roads of this country. The authors emphasise what has often been pointed out—that good roads can only be obtained by their being placed under skilled management and by maintaining a high standard of efficiency; that roads maintained in good condition cost less to keep up than those which are allowed to be rutty, uneven and covered with loose stones and mud; and that while unnecessary expenditure is to be avoided, the community ought to understand that money well spent in skilled labour and good material is often saved over and over again in time and convenience.

Morphology of Spermatophytes. By John M. Coulter, Ph.D., and Charles J. Chamberlain, Ph.D. Pp. x+188. (New York: D. Appleton and Co., 1901.) Price 1·75 dollars.

FOR a long time past a comprehensive account of the gymnosperms has been greatly needed, for within recent years many important memoirs have appeared which have thrown much light on the structure and relationships of this interesting family of plants. It is, then, with an anticipatory feeling of pleasure that one opens the first instalment of Messrs. Coulter and Chamberlain's book on the morphology of the spermatophytes, seeing that it is entirely devoted to the gymnosperms. And it may at once be said that the authors have done their work well. The book is more than a critical exposition of our present knowledge, for it embodies also the results of a considerable amount of original research on the plants in question. The illustrations are many and good, and include a large proportion of new figures.

The main groups into which the authors divide the family are dealt with in separate chapters, and *Ginkgo* is treated as the representative of a division coordinate with that of the Cycadales or of the Coniferales. The chief fossil types are also considered, and a somewhat detailed and illustrated description is given, based on a study of Dr. Wieland's preparations, of the structure of the strobilus of *Cycadoidea*.

A due proportion is maintained between the space allotted to the account of internal microscopic structure and of general morphology respectively, although naturally the former, which includes the cytological details, comes in for the greater share. Nevertheless, by no means the least interesting chapters in the book are those dealing with the comparative morphology and phylogeny of the gymnosperms as a whole. The authors would regard them as having a monophyletic origin, traceable to a Filicinean ancestry through the Cycadofilices. They base their opinion mainly on the undoubted descent of the cycads from these forms, and on the difficulty of dissociating the other gymnosperms from the cycads. They do not, however, regard the connection between the different groups as a very close one, and suggest that the Bennettitean stock may have served as the starting-point for the cycads, whilst they would refer Ginkgoales and Coniferales to a Cordaitean ancestry.

They judiciously refrain from dealing very specifically with the Gnetales. The three constituent genera, Gnetum, Tumboa (a name which one regrets to see displacing Welwitschia) and Ephedra differ so widely, both from each other as well as from the rest of the main groups, that they can only be regarded as isolated remnants of some ancient line, the affinities of which it is as yet impossible to do more than guess at.

A short sketch of the geographical distribution of the gymnosperms brings the volume to a close. The authors are to be congratulated on the ability they have displayed in producing a work which is valuable, not only as a text-book, but as a real contribution to science.

Guide Pratique pour les Calculs de Résistance des chaudières a vapeur et l'Essai des matériaux employés. Par G. Huin et E. Maire, avec la collaboration de H. Walther Meunier. "Actualitiés Scientifiques." Pp. vi+67. (Paris: Gauthier-Villars, 1901.) Price fr. 2.75.

THIS book, consisting of a collection of data and tables relating to boiler construction, is a translation of those adopted by l'Union Internationale des Associations de surveillance d'Appareils a Vapeur, which are in common use in Germany.

Part i. is devoted to formulæ, supplemented by extensive tables, for the determination of the dimensions of the principal parts of boilers.

Part ii. gives the rules relating to the selection of the material and specifies the tests to be used in any case.

The whole book covers about the same ground as the Board of Trade or Lloyd's rules for boilers, considered in greater detail and the calculations assisted by tables. The latter include, thickness of flue plates, for various lengths, diameters and pressures, thickness of shell for iron and steel, with various joints, dimensions and pressures, and the thickness of flat plates under various systems of staying.

The formulæ given are in nearly every case of the same form as those used here, but generally speaking the constants are such as to give slightly smaller dimensions.

This is due to the use of an average factor of safety of 4·5 compared with 5 required by the Board of Trade.

For the thickness of flue the formula given is Bach's

$$t=\frac{p.d}{k}\left(1+\sqrt{1+\frac{p}{k'}\,\frac{l}{l+d}}\right)+k'',$$

which should be applicable for a much wider range than our simple

$$t=\sqrt{\frac{p.l.d.}{k}}.$$

There is very little that is not to be found in an ordinary engineer's pocket book. F. H. H.

Ein Wort über den Sitz der vulkanischen Kräfte in der Gegenwart. (*Mittheilung aus dem Museum für Volkerkunde zu Leipzig.*) Von Alphons Stübel. Pp. 15; 9 figures in text, 1 coloured plate. (Leipzig: Max Weg, 1901.)

AS such a difficult subject cannot be discussed in a short notice, it must suffice to give the author's conclusions. He regards the globe as originally a liquid mass, which has become incrusted through loss of heat. This crust at first would be thin and incapable of offering an effective resistance to the struggles of the liquid interior. It would be ruptured at countless points, great floods of lava would be outpoured, without, however, the building up of important volcanic hills. At this epoch the earth may have even been surrounded by a photosphere. In the second stage the crust layer thickens to about 10 kilometres—the phenomena are similar in kind, but correspondingly reduced in extent. In the third stage the crust layer is about 25 kilometres, and the places of

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discharge from the liquid interior are fewer. Eruptions come from local reservoirs in the generally solid crust, which, however, may have a communication from beneath with the inner mass. In the fourth stage, when the crust layer approaches 50 kilometres, there is a further decline in number, though an increase in violence, of discharges from the liquid interior, but the activity of the reservoirs is maintained, and henceforth these are the main sources of vulcanicity. That is the age of catastrophic eruption, and the photosphere is disappearing. The next stage continues the cutting off of direct communication with the interior, separation takes place in the masses of magma, and local eruptions are still very violent. This phase may correspond with that stereotyped in the moon. The sixth stage begins, the seventh continues, the deposit of sediments, during which metamorphism is active in the lower beds, thus forming an outer skin to the crust layer. Eruptions continue to affect a plateau type in the earlier of these; the volume of the reservoirs is gradually being reduced, as well as the communications with the more distant interior of the earth. The eighth, in which the liquid reservoirs are few and small, and communication from within any part of the thickened crust layer to the interior very rarely exists, is the present period.

Photographic Cameras and Accessories. Edited by Paul N. Hasluck. Pp. 160. (London: Cassell and Co., Ltd., 1901.)

IT is not often that one meets with amateur photographers who possess cameras made with their own hands, because at the present day instruments can be obtained at such prices that the pocket of even the most modest purchaser can be suited. This is, however, no reason why a camera should not be home-made; and, in fact, besides affording the worker a very pleasant occupation, especially anyone who is interested in carpentry, it redounds to his credit if he turns out a good-looking and serviceable camera and produces first-class pictures with it.

The contents of this little book will afford a very ready and serviceable guide to anyone who wishes to try his hand in this direction, and supply the reader with concise information on the details of the subject of which it treats. As we are told in the preface, the matter consists essentially of a digest of material contributed by a professional photographer to a weekly journal, so that the instructions should be, and are, thoroughly practical. The text is accompanied by a great many working drawings, 241 in number, and deals, not only with the construction of the bodies of cameras, but with dark slides, shutters and stands.

Trattato elementare di Fisica. Da Oreste Murani. Vol. iii. Optics and Electricity. Second edition. Pp. xxi+675. (Milan: Ulrico Hoepli, 1901.)

THIS is a descriptive treatise in which the experimental phenomena in optics and electricity are described and the apparatus used for exhibiting or applying them are illustrated by no less than 593 woodcuts. It is essentially non-mathematical in its treatment, the few formulæ included in the text in connection with such laws as the law of refraction of light and Ohm's law involving no calculus and merely the notation of trigonometry. In regard to modern electrical discoveries and notions, Prof. Murani has brought his treatise very much up-to-date, and the experiments of Righi, Lenard, Hittorf and Hertz on electric discharges, the Röntgen and Becquerel rays, Kerr's, Hall's and Zeeman's phenomena, Tesla's experiments, wireless telegraphy, the coherer and the Wehnelt interrupter, afford instances of the many recent innovations which are described at some length. In the concluding sections the author expresses doubts as to the efficacy of lightning conductors of the old style when the effects of electromagnetic induction are taken into account. The book should be useful both as a class-book in technical colleges, for which purpose it is especially written, and as a work of reference for general readers who wish to acquire some notion of modern electricity and optics without entering into abstruse theories or technical minutiæ.

G. H. B.

A First Course of Practical Science. By J. H. Leonard, B.Sc. Pp. xii + 138. (London: John Murray, 1901.)

EXCELLENT courses of practical work in the rudiments of mensuration and physics are now available in several text-books, but there is still room for volumes like the present one. The exercises described are suitable for quite young beginners, and they will serve the double purpose of applying the pupils' knowledge of arithmetic and developing a scientific frame of mind. Simple measurements of length, area and volume, and calculations (particularly with decimals) referring to them, form the subjects of the opening chapters. Following these are laboratory exercises on weight and centre of gravity, relative weight, atmospheric pressure, thermal expansion, thermometers, latent heat, filtration, solution and distillation.

The experiments are described concisely and are well arranged, so that a pupil of average capacity could perform them without much assistance, and at the same time would acquire clear ideas on fundamental principles. We do not like such expressions as "Have all liquids got a latent heat? Have all gases got a latent heat?" but that is a detail. As a whole the book is satisfactory, and, with others of the same kind, will assist the movement in favour of introducing scientific measurements in early stages of instruction in schools. Dr. Gladstone contributes a short preface.

Coltivazione delle Miniere. By S. Bertolio. Pp. vii+284, with 96 figures. (Milan: Hoepli, 1902 [*sic*]. Price L. 2·50.)

THIS is one of the numerous manuals published by Hoepli of Milan; it contains a useful little epitome of the art of mining. It is not fair to expect too much from a book costing only 2*s*., and consequently one must not carp too loudly at the absence of detailed descriptions and figures of certain important mining appliances. Steam shovels and dredges, which play so weighty a part nowadays, are merely mentioned by name, and hydraulic mining is dismissed in a couple of lines. This defect should be remedied in a second edition, for it is well even in a small manual to impress upon the student the great importance of all mechanical methods of excavation.

On the other hand, the author deserves credit for his picture of the well-marked projecting outcrops of three parallel lodes at Montevecchio in Sardinia; the student has not always the opportunity of seeing such a fine example in the field. Mistakes in foreign words are too frequent, and when the simple name of the inventor of the safety-lamp is spelt "Dawy," the Englishman feels aggrieved; however, all nations are treated alike, for the author is not absolutely faultless in his own tongue.

The Ballads and Shorter Poems of Frederick V. Schiller. Translated into English Verse by Gilbert Clark, M.A. Pp. xv+408. (London: Williams and Norgate.)

SCHILLER'S philosophical writings have admirers in the world of science, and this translation will contribute to the wider appreciation of his poems among people unable to read them in the original. The series of poetical parables and riddles referring to natural phenomena, and the verses on astronomy, astronomers, nature knowledge and transcendental philosophy are of interest to scientific minds.

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